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ABSTRACTS FROM ASTRONOMICAL PUBLICATIONS.

SOUTHERN DOUBLE STARS.

It is a pleasure to note the attention that is being given to the observation and discovery of double stars in the Southern Hemisphere. Mr. Innes has long been recognized as the leader in this work, his discoveries reaching a total of nearly 1100 pairs, and his measures of known pairs being far more extensive than those of any other observer in the Southern Hemisphere. In *Circular No. 33*, of the Union Observatory, South Africa, recently distributed, the fifth series of "Measures of Southern Double Stars," made with the 9-inch Grubb refractor, is printed. The measures, by Mr. Innes and his associates at the Union Observatory, are made in the same manner as those in the four earlier series, each pair being measured on one night when east of the meridian and on another when west. If the agreement of the two sets is not satisfactory, two additional sets, similarly divided, are made. The eyes, while observing, are held parallel or perpendicular to the line joining the two stars. With these precautions it is hoped that systematic errors of measurement may, for the most part, be eliminated.

The five series of measures contain, in all, about 1500 pairs, many of them so close as to reach the limit of the theoretical resolving power (about 0".5) of the telescope. This fact, and the statement by Mr. Innes, that there are only one or two nights a year when it is not possible to measure with ease pairs whose angular separation is 0".90, provided the two components are sensibly equal in magnitude, testify to the favorable observing conditions at Johannesburg and also to the excellence of the telescope.

As in the earlier series, Mr. Innes appends notes to the present list of measures, which add decidedly to the value of the paper. Of special interest to the present writer is the statement that wide and easy pairs, like many of the *h* pairs, are not to be observed hereafter, since motion in such pairs "will be disclosed with accuracy and certainty by the examination under the blink-microscope of pairs of astrographic (or other) plates taken at different epochs."

It is to be regretted that the war has seriously affected the work of the Union Observatory, not only by removing to some unknown future date the completion of the large telescope partly constructed for it, but by leaving the institution short handed. "* * * at present the staff is reduced to Mr. Innes and Mr. Wood, with two lady assistants who do the clerical and meteorological work."

In addition to the five series mentioned above, *Circular No. 27* contains a series of measures made with the 9-inch refractor by M. J. Voûte, of the Cape Observatory, during two visits to Johannesburg early in 1915. M. Voûte used the reversing prism in his measures, as in his earlier work at the Leiden Observatory, his chief object being to determine whether the elimination of systematic errors by its use "is efficient under different conditions of the instrument and place of observation." His conclusion favors the use of the prism, the probable error of measure being decidedly reduced thereby.

Professor W. J. Hussey has also been making important contributions to our knowledge of southern double stars by his work with the 17-inch refractor of the La Plata Observatory. In Part II of Volume I of the *Publications of the Astronomical Observatory of the University of Michigan,* are printed two lists of new double stars (the first of which had also been printed in Tomo I of the *Publicaciones* of the La Plata Observatory) which, together, include 311* pairs, and also a list of measures of nearly 200 other double stars south of —17° declination.

Some of the stars in all three of these lists have been measured on one night only, and some of the new pairs in the first list (13th Catalog) have not been measured at all, because no micrometer was available at the time of their discovery. The great majority, however, have been measured on two or more nights each.

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*Mr. Innes points out that 17 pairs previously discovered and measured by other observers are included in the two lists. The 14th Catalog contains only 99 stars, there being no number 1621.

In general, the new *Hu* pairs are of the same character as those discovered by Mr. Hussey while at the Lick Observatory, about 57 per cent. of those in the first list, and 70 per cent. of those in the second falling within the limit of 2″ in angular separation. A considerable percentage, however, are relatively faint pairs with angular separation well above the limits of 5″ adopted in work at the Lick Observatory, the widest pairs being *Hu* 1349 and *Hu* 1555, with distances 8″.85 and 8.″74 and magnitudes 9.0–10.5 and 9.1–9.8, respectively.

It is to be hoped that the double star work at both of these southern observatories may be carried on vigorously.

R. G. Aitken.

May, 1916.

Stellar Magnitudes of the Sun, Moon and Planets and the Albedo of the Planets and Satellites.

In the March, 1916, number of the *Astrophysical Journal*, Professor H. N. Russell presents a careful discussion of all existing photometric data of the Sun, Moon and planets and a determination from these of the most probable values of the stellar magnitudes on the Harvard scale of these objects. A critical comparison of the seven series of observations of the relative brightness of the Moon at different phases is made, and a satisfactory representation by a mean light-curve of all the observations is obtained. Attention is called to the fact that the full Moon is 8.7 times brighter than the first quarter, and 10.0 times brighter than the last quarter.

As the value of the visual stellar magnitude of the Sun he adopts the simple mean of the determinations by Zöllner, Fabry, Pickering and Ceraski, whose observations altho obtained by very different methods are in remarkable agreement. The visual magnitude of the Sun on the Harvard scale is then —26.72 $\pm 0^m.04$. From the weighted mean of King's and Birck's observations, the Sun's photographic magnitude is —25.93. Its color index is therefore $+0^m.79$, in good agreement with King's value of $0^m.72$ for stars of Class G.

Stellar magnitudes of the planets are based chiefly on the very extended series of observations by Müller, which for the brighter planets are found to require a correction of approximately $-0^m.06$ in order to reduce them to the Harvard system. For *Uranus* and *Neptune* no correction appears necessary. King's observations of the photographic magnitudes of the planets have been adopted in the present work.

Determinations of the stellar magnitude of the mean full Moon made by different observers are quite discordant and the value of this important constant is still subject to considerable uncertainty. For its value he has adopted the weighted mean of five series of observations, excluding all those which were obviously affected by systematic errors.

A second paper by the same author appearing in the *Astrophysical Journal* for April, 1916, is devoted to the determination of the albedo of the Moon, planets and brighter asteroids and satellites, on the basis of their adopted magnitudes, and to a discussion of the material bearing upon the albedo of the Earth.

Accepting Bond's definition of "albedo" as the ratio of the amount of light reflected in all directions by a sphere, to the total incident light when the sphere is illuminated by parallel rays, it is shown that the albedo may be expressed as the product of two factors. One of these depends only upon the law of the variation of the planet's light with phase, while the other factor (p) is the ordinary reflecting power (frequently called albedo), or the ratio of the observed brightness at full phase to that which would be obtained by replacing the planet by a flat disk of the same diameter as the planet.

A few values of the stellar magnitudes (m), reflecting power (p), visual albedo, color index, and photographic albedo are here given for the objects which are of general interest:

Object	*m*	*p*	Visual Albedo	Color Index	Photographic Albedo
Moon	—12.55	0.105	0.073	+1.18	0.051
Mercury	— 2.94	.164	.069	......	.....
	— 2.12	.077	.055	......	.....
Venus	— 4.77	.492	.59	+0.78	.60
Mars	— 1.85	.139	.154	+1.38	.09
Jupiter	— 2.29	.375	.56	+0.50	.73
Saturn	+ 0.89	.420	.63	+1.12	0.47
Uranus	+ 5.74	.42	.63	......	.....
Neptune	+ 7.65	.49	.73	......	.....

The values of *m* are for mean opposition, except those for *Mercury* and *Venus;* they are for mean distance from the Sun and unit distance from the Earth. Two sets of values are given for *Mercury,* computed respectively by Müller's linear empirical formula, and by his quadratic formula.

The results for the brightness of the Earth and its stellar magnitude are deduced from Very's recent observations of the intensity of the earth-shine on several different assumptions regarding the variation of the Earth's brightness with phase. On the assumption that this variation is the same as that for *Venus,* the stellar magnitude of the Earth as seen from the Sun is —3.8, its reflecting power (*p*) 0.37 and its visual albedo 0.45. Very's value of the Earth's albedo, 0.89, is shown to result from the use of Zöllner's value of the Moon's "true albedo" instead of its "apparent albedo." When this correction is made, Very's computation gives for the Earth's visual albedo 0.49, a result which instead of being inconsistent with Abbot's value of the solar constant, is actually in good agreement with it.

Professor Russell repeatedly calls attention to the urgent need of further observations of these fundamental photometric constants with modern precision, a piece of research which he says "would well repay the undivided attention of a competent observer for a considerable time."

J. H. Moore.

May, 1916.

THE EXTENSION OF THE SPECTRUM IN THE ULTRA VIOLET.

The light vibrations which affect our eyes or which are used in the ordinary processes of photography form only a few octaves, if we may borrow the term, in the extended gamut of ether vibrations, and all explorations which extend our knowledge of these vibrations beyond the red or below the violet of our ordinary spectrum possess a very great theoretic interest and may eventually prove to be of great value in spectroscopic theories of the constitution of matter.

The gradual process of exploration which has extended our knowledge of the spectrum below the limit of the human eye in the violet (wave-length about 4000 A) forms, with its record of successive obstacles overcome, one of the most interesting recent chapters of experimental research.

With glass prisms and lenses the lower limit of the spectrum was first pushed to about 3000 A; at this point glass becomes opaque to these short vibrations, and the next step was to use quartz prisms and lenses or reflecting gratings, by means of which the lower limit was reached at about 1850 A. Below this point not only does the gelatine of the ordinary photographic plate become opaque, but even a few inches of air cuts off these short waves as effectually as a screen of metal, and such substances as quartz and fluorite rapidly lose all power of transmission. This obstacle was in turn overcome by Schumann, who, by the invention of a special photographic plate very deficient in gelatine and by exhausting the air from his apparatus, was enabled to record spectral lines of as short a wave-length as 1250 A; at this point he was stopped by the opacity of the fluorite of which his lenses were made.

Professor Theodore Lyman was able, by employing a reflection grating and by filling his spectrograph with hydrogen gas, to reach the extremely short wave-length of 900 A in 1914. His paper in the *Astrophysical Journal* for March, 1916, of which this is a brief abstract, describes his further experiments in this interesting line of research. Finding that hydrogen, in its turn, had become opaque as far as wave-lengths shorter than 900 A were concerned, he turned his attention to helium, and by using this gas and by certain improvements in his apparatus he has succeeded in reaching the phenomenally short wave-length of 599 A, the present "farthest south" in this field of investigation.

Aside from the precautions which must be taken to render the apparatus leak-proof and to secure purity in the gases employed to fill the spectrograph, when one considers that each separate plate must be sealed inside the spectrograph, the air exhausted, the instrument filled with helium, and that then the apparatus must be taken apart to get out the plate after the exposure has been made, one obtains perhaps a slight idea of the difficulties of spectrum exploration in this region.

Only a few of the lines found have been identified with any certainty; a puzzling aspect of the results is that many of the strongest lines appear to be about equally strong in nitrogen, helium or argon, and are perhaps to be attributed to some subtle impurity.

The X-rays have a wave-length of the order of one angstrom; there is thus a gap of about 600 A between the wave-length of the X-rays and the limit reached by Lyman, who believes that this gap may be further shortened by purely spectroscopic means. It will certainly be a discovery of great interest when the point of transition shall be reached between the X-ray, to which many solids are apparently as transparent as is glass to ordinary light, and these short light-waves, to which a slight thickness of air or a half millimeter of quartz appears as effectually opaque as an equal thickness of steel.

H. D. CURTIS.

A VARIATION IN THE SOLAR ROTATION.

In the *Astrophysical Journal* for March, 1916, Professor Plaskett gives the results of his investigations on the rotation period of the Sun made at Ottawa in 1915. The method followed the general lines suggested in the conferences of the

International Solar Union, and the plates were grouped in point of time in such a way as to give data for the detection of variations in the rotation period of the Sun, whether of short or long period.

No evidence was secured which would warrant the assumption of a very short period variation in the solar rotation. The results, however, seem to point with considerable definiteness to a periodic variation in the speed of solar rotation at the equator with a period of roughly one month, and a range of about 0.15 kilometer per second. With regard to a secular change in the time of rotation the angular speed of rotation found from the 1915 results is 13°.83 per day, while the 1913 results gave a value of 14°.14 per day, apparently indicating that there had been a real change in the interim. The conclusion reached from a discussion of results secured at Ottawa and elsewhere is that since 1906 the equatorial rotation value has been slowly falling from 2.050 to 1.950 kilometers per second.

Tho such a result seems at first sight incomprehensible in a body so enormous as the Sun, one must remember that the phenomena are doubtless associated with a relatively thin surface layer, a layer which we know from sun-spot and other spectroscopic observations is rotating at different speeds from the equator of the Sun to its poles with occasional abnormal values and vagaries which still await adequate explanation. Some discussion is made in the paper quoted, showing the possibility of a physical explanation of such a variable velocity in accordance with Professor Emden's solar theory. A surface layer which shows so remarkable a change in its behavior as that exemplified by the difference between the epochs of sun-spot maximum and sun-spot minimum might well be expected to show similar abnormalities in its apparent speed of rotation.

H. D. CURTIS.

May, 1916.

The *Astronomical Journal* Nos. 686-687 contains the definitive orbit of Comet 1855 II, by Georges van Biesbroeck, of Yerkes Observatory. As the comet was observed for only fifteen days but fifty determinations of position were available; the resulting elements satisfy all the observations well; an elliptic orbit is indicated with a period of several hundred years. The orbit shows some resemblances to that of the first comet of 1362, and a rediscussion of the Chinese observations of the latter comet is made in the endeavor to connect the two bodies as apparitions of the same comet, tho it is pointed out that the comet of 1362 was a striking object, while that known as 1855 II was barely visible to the unaided eye. The author comes to the conclusion that the identity of comet 1855 II with that of 1362 can not be considered as in any way proved.

REVIEW

Two Books on Meteorites.

Students of meteorites will be interested in two volumes by Dr. Farrington, Curator of Geology in the Field Museum of Natural History, Chicago, which have appeared recently.

A *Catalogue of the Meteorites of North America* was issued a few months ago as Volume XIII, *Memoirs of the National Academy of Sciences;* 513 quarto pages of text, and 36 full-page sectional maps of North America. It treats of 247 objects or "falls" recognized by Dr. Farrington as *bona-fide* meteorites up to January 1, 1909. Of the 247, the iron meteorites number 161, the iron-stone meteorites 10, and the stony meteorites 76. Of the three kinds, 3 iron, 1 iron-stone, and 56 stone meteorites were actually seen to fall, but Dr. Farrington is convinced that the remaining 187 "finds" represent real "falls." Doubtful cases have been excluded. The phenomena of each fall and find, the shape, size, chemical composition, and mineralogical structure of each object, are described in good fullness, but completeness is obviously impossible in the cases which include many specimens in one fall or find. The Canyon Diablo group, for example, includes thousands of meteorites of a great variety of forms and sizes,